

AMENDMENTS TO THE CLAIMS

Listing of claims:

This listing of claims replaces all prior versions and listings of claims in the application.

1. (Original) A manufacturing method of a semiconductor device, comprising the steps of:

forming a silicon substrate with a normal of a surface extending in an inclined direction from a [100] direction; and

forming a semiconductor element with a moving direction of carriers being in a [001] direction, on the surface of the silicon substrate,

wherein when an angle of inclination of the normal is decomposed into a component in the [001] direction and a component in a [010] direction, the component in the [001] direction is made within ± 0.2 degrees, and

said step of forming the semiconductor element comprises the step of reconstituting steps existing on the surface of the silicon substrate by performing thermal treatment.

2. (Original) A manufacturing method of a semiconductor device, comprising the steps of:

forming a silicon substrate with a normal of a surface extending in an inclined direction from a [100] direction;

forming an epitaxial layer on the silicon substrate; and

forming a semiconductor element with a moving direction of carriers being in a [001] direction, on a surface of the epitaxial layer,

wherein when an angle of inclination of the normal is decomposed into a component in the [001] direction and a component in a [010] direction, the component in the [001] direction is made within ± 0.2 degrees, and

said step of forming the semiconductor element comprises the step of reconstituting steps existing on the surface of the epitaxial layer by performing thermal treatment.

3. (Original) The manufacturing method of the semiconductor device according to claim 1, wherein the component in the [001] direction is made within ± 0.15 degrees.

4. (Original) The manufacturing method of the semiconductor device according to claim 2, wherein the component in the [001] direction is made within ± 0.15 degrees.

5. (Original) The manufacturing method of the semiconductor device according to claim 1, wherein the component in the [001] direction is made within ± 0.05 degrees.

6. (Original) The manufacturing method of the semiconductor device according to claim 2, wherein the component in the [001] direction is made within ± 0.05 degrees.

7. (Original) The manufacturing method of the semiconductor device according to claim 1, wherein the component in the [010] direction is made within ± 0.5 degrees.

8. (Original) The manufacturing method of the semiconductor device according to claim 2, wherein the component in the [010] direction is made within ± 0.5 degrees.

9. (Original) The manufacturing method of the semiconductor device according to claim 1,

wherein in said step of forming the semiconductor element,
the thermal treatment is performed in a hydrogen atmosphere, and
after said step of reconstituting the steps, an insulation film is formed on the silicon substrate.

10. (Original) The manufacturing method of the semiconductor device according to claim 9, further comprising the step of performing chemical solution cleaning for the surface of the silicon substrate, before said step of performing the thermal treatment in the hydrogen atmosphere.

11. (Original) The manufacturing method of the semiconductor device according to claim 2,

wherein in said step of forming the semiconductor element,
the thermal treatment is performed in a hydrogen atmosphere, and
after said step of reconstituting the steps, an insulation film is formed on the epitaxial layer.

12. (Original) The manufacturing method of the semiconductor device according to claim 11, further comprising the step of performing chemical solution cleaning for the surface of the epitaxial layer, before said step of performing the thermal treatment in the hydrogen atmosphere.

13. (Original) The manufacturing method of the semiconductor device according to claim 9,
wherein in said step of performing the thermal treatment in the hydrogen atmosphere, a rapid heating and rapid cooling device is used.

14. (Original) The manufacturing method of the semiconductor device according to claim 11,
wherein in said step of performing the thermal treatment in the hydrogen atmosphere, a rapid heating and rapid cooling device is used.

15. (Previously Presented) A manufacturing method of a semiconductor device, comprising the steps of:

forming a silicon substrate with a normal of a surface extending in an inclined direction from a [100] direction; and

forming a semiconductor element with a moving direction of carriers being in a [001] direction, on the surface of the silicon substrate,

said step of forming the semiconductor element comprises the step of reconstituting steps existing on the surface of the silicon substrate by performing thermal treatment in a hydrogen atmosphere at 950°C to 1050°C for 60 seconds or less ,

wherein when an angle of inclination of the normal is decomposed into a component in the [001] direction and a component in a [010] direction, the component in the [001] direction is made within ± 0.2 degrees,

wherein after said step of reconstituting the steps, an insulation film is formed on the silicon substrate.

16. (Previously Presented) A manufacturing method of a semiconductor device, comprising the steps of:

forming a silicon substrate with a normal of a surface extending in an inclined direction from a [100] direction;

forming an epitaxial layer on the silicon substrate; and

forming a semiconductor element with a moving direction of carriers being in a [001] direction, on a surface of the epitaxial layer,

said step of forming the semiconductor element comprises the step of reconstituting steps existing on the surface of the epitaxial layer by performing thermal treatment in a hydrogen atmosphere at 950°C to 1050°C for 60 seconds or less,

wherein when an angle of inclination of the normal is decomposed into a component in the [001] direction and a component in a [010] direction, the component in the [001] direction is made within ± 0.2 degrees, and

wherein after said step of reconstituting the steps, an insulation film is formed on the epitaxial layer.

17. (Original) The manufacturing method of the semiconductor device according to claim 9,

wherein in said step of performing the thermal treatment in the hydrogen atmosphere, the thermal treatment is performed under lower pressure than normal pressure.

18. (Original) The manufacturing method of the semiconductor device according to claim 11,

wherein in said step of performing the thermal treatment in the hydrogen atmosphere, the thermal treatment is performed under lower pressure than normal pressure.

19. (Original) The manufacturing method of the semiconductor device according to claim 9,

wherein said step of forming the semiconductor element comprises the step of forming a gate electrode of a MOS transistor on the insulation film.

20. (Original) The manufacturing method of the semiconductor device according to claim 11,

wherein said step of forming the semiconductor element comprises the step of forming a gate electrode of a MOS transistor on the insulation film.

21. (Original) The manufacturing method of the semiconductor device according to claim 19,

wherein said step of forming the semiconductor element comprises the step of forming a source and a drain so that the moving direction of the carriers in a channel of the MOS transistor is in the [001] direction.

22. (Original) The manufacturing method of the semiconductor device according to claim 20,

wherein said step of forming the semiconductor element comprises the step of forming a source and a drain so that the moving direction of the carriers in a channel of the MOS transistor is in the [001] direction.

23. (Original) The manufacturing method of the semiconductor device according to claim 1,

wherein said step of forming the silicon substrate comprises the steps of:
growing a bulk of single crystal silicon in the [100] direction; and
cutting the silicon substrate from the bulk.

24. (Original) The manufacturing method of the semiconductor device according to claim 2,

wherein said step of forming the silicon substrate comprises the steps of:
growing a bulk of a single crystal silicon in the [100] direction; and
cutting the silicon substrate from the bulk.

25. (Original) The manufacturing method of the semiconductor device according to claim 23,

wherein in said step of growing the bulk of the single crystal silicon, a Czochralski method is adopted.

26. (Original) The manufacturing method of the semiconductor device according to claim 24,

wherein in said step of growing the bulk of the single crystal silicon, a Czochralski method is adopted.

27. (Original) The manufacturing method of the semiconductor device according to claim 1, further comprising the step of forming an element isolation region on the surface of the silicon substrate, before said step of performing the thermal treatment in the hydrogen atmosphere.

28. (Currently Amended) A ~~manufacturing apparatus of a semiconductor device~~[[,]] comprising:

~~a substrate forming unit for forming~~ a silicon substrate with a normal of a surface extending in an inclined direction from a [100] direction[[,]]; ~~and~~
~~a thermal treatment unit for reconstituting steps existing on the surface of the silicon substrate by thermal treatment,~~

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~~wherein said substrate forming unit makes a~~ the component in the [001] direction being within
±0.2 degrees (~~excluding 0 degree~~) when an angle of inclination of the normal is decomposed into
[[the]] a component in the [001] direction and a component in a [010] direction, and steps
existing on the surface of the silicon substrate having been reconstituted by thermal treatment;
and

a semiconductor element with a moving direction of carriers being in a [001] direction,
on the surface of the silicon substrate.